Geochemical characterization of groundwater and saltwater intrusion processes along the Luy River, Binh Thuan, Vietnam

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Introduction

Binh Thuan province is one of the driest places in Vietnam with an average annual rainfall of 800-1150 mm/year. In 2012, the national center for water resources (Nawapi, 2012) delineated the seawater intrusion extent in Binh Thuan based on the total dissolved solid (TDS) content of water samples taken from shallow borehole with the threshold of 3g/L and 1.5g/L were exceeded in the estuaries of the Luy river. In the recent years, the prolonged droughts combined with the sea level rise and the over-extraction of groundwater during the dry season increased dramatically the saltwater intrusion process especially in the estuaries of the province.

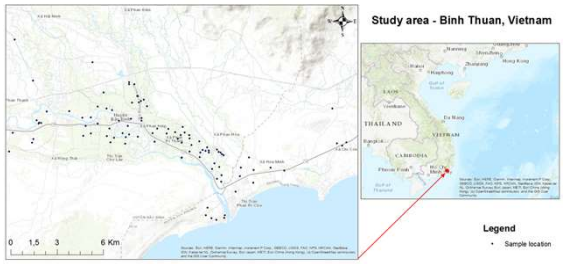

Figure 1: Study area in Luy river catchment, Binh Thuan, Vietnam

Method and Results

The geochemistry of groundwater in the Luy River catchment was studied to investigate the contamination of the aquifers and identify the processes taking place. From 1991 to 2015, 98 water samples had been taken from the wells in the area in both dry and rain seasons. 71% of the water samples were fresh while 21% and 5% were lightly saline and moderately saline respectively. In the summer 2020, 110 new water samples from both shallow and deep wells were collected in the Luy river catchment in wells from 3m to 40m. The TDS values are ranging from 105 to 23080 mg/L and can be classified into 4 groups: fresh water (48%), slightly saline (40%), moderately saline (8%) and very saline (4%). The samples show that the saltwater intrusion expands not only horizontally at shallow depth along the river but also deeper down the aquifer in most of the study area, what is also confirmed by geophysical data. Freshwater samples were mostly collected at depth lower than 10m.

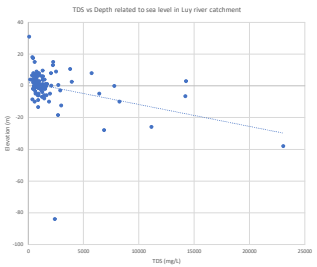

Figure 2: The relationship between TDS vs depth in Luy river catchment

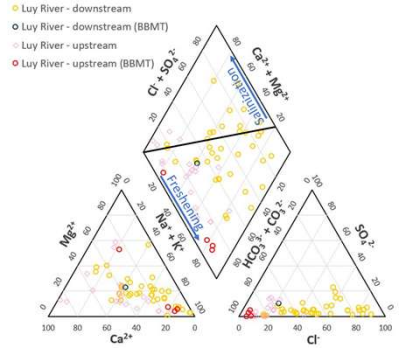

Figure 3: Piper plot of previous water samples in Luy river catchment

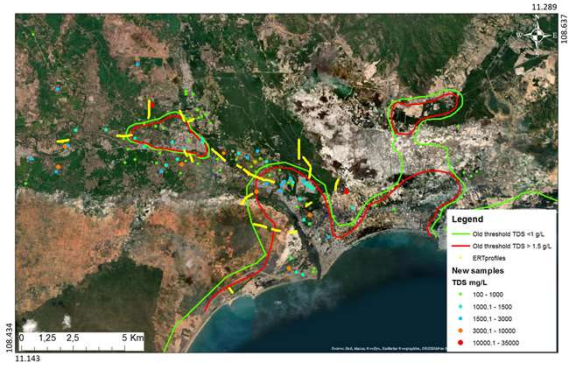

Figure 4: Distribution of water samples with TDS groups in Luy river catchment

Conclusion

The chemical composition of water samples was analyzed showing evidences of seawater intrusion, but also the occurrence of freshening processes within the study area. Together with the presence of saltwater at larger depths, this points towards a situation more complex than previously thought. Saltwater intrusions are likely not only related to interaction with the river estuary, but also to the presence of fossil saltwater in the aquifer, and to groundwater pumping and irrigation practices.

References

NAWAPI. 2012. Hydrogeological mapping at scale 1:50000 in Ninh Thuan and Binh Thuan provinces. In Vietnamese.

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